

mical combination going on. Thus it was that the key to the inner temple of Nature had been found by Priestley and given to Lavoisier, who, with it, unlocked the inner shrine and threw open to the blaze of day secrets which had been hidden from mortals. Then followed Dalton, who, with his law of combining proportions, explained the mystic numbers by which Nature works, and demonstrated the truth dimly hinted by philosophers and seers of old, that God has ordered all things by number, by weight and by measure. We do not suppose that the chemists who will meet at Northumberland will propose to place Priestley in the same rank of philosophers with Lavoisier; but the time they have selected for commemoration has been happily chosen—the moment of the discovery of oxygen. For oxygen is truly the Prince of the Power of the Air entering into combination with all things, and always triumphing at last in its ceaseless warfare with the vital forces.

Joseph Priestley was born in 1733, near Leeds. His education was irregular and imperfect, although, from various teachers at different times, and by unaided labour he acquired considerable knowledge of languages and a smattering of mathematics. In Hebrew and Greek he excelled, and throughout his life he continued to study the Bible in its original languages. He early evinced an aptitude for physical investigation, and a curiosity, well nigh insatiable, for all branches of knowledge. Even in chemistry, however, he was by no means thorough. Many of the usual processes were unknown to him, and he failed in consequence to obtain a professorship for which he competed in that science. Hence he could not draw from his own brilliant discoveries the important inferences which at once suggested themselves to the more philosophic mind of Lavoisier. He was brought up in the most rigid tenets of Calvinism, and studied for the ministry at Daventry. On taking orders he obtained an appointment to a chapel at Needham Market, where he remained until 1758. But his independence and originality of mind troubled him there, as in fact was the case all through his life. He had doubts about original sin and eternal damnation, which his congregation would not tolerate, and in consequence he was obliged to resort for a time to teaching. After several changes he at last settled at Birmingham, in 1780, where he remained almost up to the period when he left England for the United States. During all this time Priestley wrote incessantly. His works, although now seldom met with, are exceedingly voluminous, and treat upon almost every conceivable subject. He wrote upon the theory of language, on oratory, on criticism, on constitutional law, on history, on optics, but his favourite subject was theology. These productions, alternated with acrid defences of the Christian religion in reply to Paine, Gibbon and Volney, violent tracts on the French Revolution, and memoirs on chemical researches which from time to time he contributed to the Royal Society. There was no philosophic calm about Priestley. In his discussions he strongly manifested the odium theologium, combined with scientific and political zeal. He took a keen interest in political matters—sided, of course, with the revolted American colonies, and, when the French Revolution broke out, justified it even at the time of its worst excesses.

In recognition of his advocacy and of his scientific reputation the French nation, which guillotined Lavoisier, declared Priestley to be a citizen of France, and the department of the Orne elected him as representative to the National Convention. He declined to take his seat, pleading his deficient acquaintance with the French language. Society in England, however, looked coldly upon him. The national mind was excited by its deep and bitter hatred of the revolutionary ideas of France. His papers began to be refused by the learned societies, and he was made to feel the popular dislike in many ways. To deny the doctrine of original sin was bad enough, to doubt eternal damnation was worse, but when he openly avowed his sympathy with the Revolutionary Government, and even commemorated the anniversary of the taking of the Bastille, the British Philistine arose in his might, assailed the chapel and the dwelling of the heterodox doctor, gutted the buildings, smashed his apparatus, destroyed his books and manuscripts, and testified in so violent a manner to the popular love of sound political and religious tenets, that the doctor left Birmingham for ever, and before long quitted the shores of England, and settled upon a farm at Northumberland, in Pennsylvania.

Now, it must be said that, wrong as it undoubtedly was of the British Philistine to act in that incoherent and illogical way, he was very unnecessarily provoked by Priestley's flaunting style of airing his religious and social hobbies. The doctor was incessantly attacking or being attacked. He assailed most violently Gibbon, Hume, Paine, or Volney, or anybody in fact, who went further than he thought proper in the path of heterodoxy; while he was defending with the same acridity the particular stripe of heterodoxy which he himself had conscientiously adopted. The great British public would not endure so much originality, and therefore, they tore the doctor's house down, utterly regardless of their obligations

to that same originality in discovering oxygen, hydrochloric, and nitrous gas. Thus the divine right of kings and the doctrine of original sin were gloriously vindicated at the same time.

Although by the discovery of oxygen Priestley enabled Lavoisier utterly to explode the current theory of combustion, yet he himself, with a perverseness incomprehensible, clung to the doctrine of *Phlogiston* with the utmost tenacity. A man less conscientious than Priestley would eagerly have adopted a new theory which grew out of his own discovery; but in Priestley there was a love of truth, mixed with a peculiar perverseness, which led him to his dying day to combat for *Phlogiston* with the same zeal as he did against original sin. He never was able to take that broad view of the facts established by his researches which characterised Lavoisier, and he remained with an inconsistency peculiarly his own as conservative in science as he was radical in religion and politics.

Before we can rightly appreciate the enormous stride which chemistry has made since the discovery of oxygen, we must dwell a moment upon the theory of *Phlogiston*. It seems scarcely credible that all chemists should have believed in the existence of an invisible substance which was not only imponderable, but even, to borrow a term from algebra, negatively ponderable. *Phlogiston* was a gas or inflammable ether which added lightness, as well as inflammability, to the substance with which it combined. Let a pound of pure iron be rusted (or oxidised) to red oxide, it will be found to have gained about two-fifths in weight. It has combined with something, said Lavoisier; not so, replied Priestley, and all the old school, it has *lost* *Phlogiston*, it cannot be burned any more. Let the same oxide be reduced to the condition of metallic iron—it has now, they said *gained* *Phlogiston*; it is combustible, and may be burnt. It is true it is lighter, but *Phlogiston* is an element of lightness. We repeat, though true, it is scarcely credible that such a theory should ever have been held against Lavoisier by such men as Priestley and Cavendish. This *Phlogiston* was, in fact, nothing but the elementary fire of which Lucretius wrote, and the Greek physicists. It has lasted up to one hundred years ago. Nor can we, in the present day, claim to be free from French theories. Tyndall's theory of interstellar ether is equally undemonstrable, although it must serve until a better be found, but *Phlogiston* is the quintessence of pure reason compared with Sir Wm. Thompson's theory, that all living things have sprung from germs carried to our earth by stray *aerolites* from some other world.

The grand experiment which will be commemorated on August 1st is familiar now to every schoolboy. Dr. Priestley placed in a tube some red oxide of mercury ("the red precipitate," familiar to druggists), and connected the tube with a pneumatic apparatus. Then, applying heat by means of a powerful lens, he had the satisfaction of seeing a gas come bubbling up which, when examined, differed greatly from common air, while the red crystalline powder gradually took on the bright fluid appearance of metallic mercury. This was the critical experiment which changed the course of chemical science and—although it was afterwards shown that there are modes of combustion which do not depend upon oxygen, as for instance the burning of metals, under certain conditions, in chloride—the theory which Lavoisier based upon Priestley's discovery is, with minor adaptations, the theory which has guided chemists and analysts to its most brilliant triumphs.

2. PRECAUTIONS AGAINST FIRE.

GENERAL HINTS IN CASE OF FIRE, AND ON MEANS OF PREVENTION.

1. Be well acquainted with the best means of escape from your house, at both the top and the bottom.
2. Do not get confused; admit no one to your house except firemen, and policemen, or neighbours.
3. If a lady's or child's dress takes fire, endeavour to roll the person up in a rug or carpet, or any piece of woollen stuff.
4. Keep all doors and windows closed until the firemen arrive.
5. Always keep a piece of rope sufficiently long to reach the sidewalk, in case you cannot make your exit by the stairway.
6. If you cannot make your way from a building by the stairway, endeavour to get in a front room, and be careful to keep all doors shut behind you, for smoke will follow a draft and flames the smoke. If smoke enter the room and it is difficult to stand erect, get your mouth as close to the floor as possible and breath easy, as there is always a current of fresh air near the floor. A wet cloth over the mouth will aid breathing.
7. In getting smoke from a room, always open the upper portion of a window.
8. In case of a fire in a theatre, or any place where numbers of persons are, keep perfectly cool, and do all you can to prevent a panic, as there is generally plenty of time to escape, if there is no panic.